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FLIGHT EVALUATION OF THE CONCEPT OF THE STAGE A PERIPHERAL VISION HORIZON DEVICE (PVHD) USING THE CH 135 AIRCRAFT OF 403 SQUADRON - CFB GAGETOWN.

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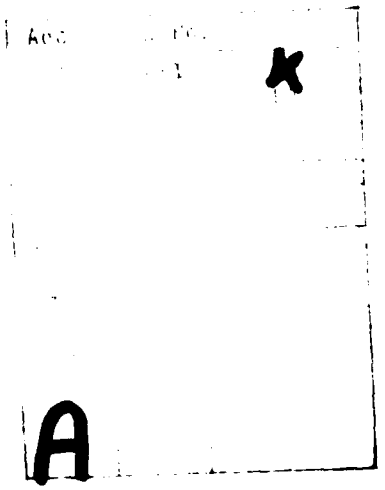

ABSTRACT

The PVHD is an aircraft flight attitude instrument which uses the principle that visual sensory orientation information reaches the brain via the peripheral visual pathways. The instrument is currently in a developmental stage but six workable models have been manufactured under contract for the Department of National Defence (DND) by Varian Canada Incorporated (VCI). In order to evaluate the concept under operational conditions, it was necessary to install the system in an aircraft and fly it under variable weather conditions in various types of missions. The CH 135 (Huey) helicopter was chosen for the conceptual flight trials and 403 Squadron (CFB Gagetown) was tasked to fly the system. The system was flown for approximately 35 hours by several different pilots under visual meteorological conditions (VMC), instrument meteorological conditions (IMC), simulated instrument flying (SIF), in many missions both day and night. Daily and weekly utilization logs and reports were recorded by the pilots. At the end of the flight trial, each pilot reported his impressions on a questionnaire. Flying times under various conditions are reported along with the impressions of the pilots who flew the system. Recommendations for further operational studies are made.

INTRODUCTION

In 1966 the hypothesis was proposed that visual sensory information affecting orientation in space was probably sensed mainly by the peripheral visual system and transmitted to the brain to a subconscious reception area. This being the case, the best method of providing information about the horizon is probably to project an "artificial" horizon across the pilot's field of vision so that it could be sensed in the peripheral visual fields as opposed to the present method of determining the horizon by using foveal vision to interpret the small attitude indicator (AI) and translate that to the conscious brain.

By 1973, a flyable "breadboard" PVHD model was constructed and in 1974 it was flown in the CH 124 (Seaking) simulator. In 1975 it was flown in an Air Canada DC-8 aircraft, Boeing 747 simulator, single Otter and in the CH 136 (Kiowa) and CH 135 (Huey) helicopters. In early 1976 it was flown in the Seaking helicopter at CFB Shearwater. Considerable pilot enthusiasm for the concept led to further impetus to pursue the development.

To date six "stage A" models have been built for DND under contract by Varian Canada Inc. These models consist mainly of three parts: a lamp assembly and projector, a power supply module, and a pilot's control panel. The device operates by receiving signals from an aircraft gyro, processing them in the power supply module, and transmitting them to the lamp assembly which projects the light bar onto the instrument panel using pitch and roll axis servo motors. The pilots' remote control panel contains off, on, and standby switches, light bar positions and intensity controls and a pitch scale control. The aim of the trial was to evluate the human factors aspect of the PVHD using the CH 135 aircraft in the routine tactical role. It was made clear to the pilots that the hardware was not being evaluated during these trials.

METHOD

Direction for the trial was provided by the trial directive (Ref 1). Three Stage A models were delivered to 403 Squadron in late June and the installation was begun about mid-July following some minor procurement problems with cables and hardware. In late July, DCIEM presented a pre-trial briefing to the Squadron and flying commenced 31 July 1980.

The equipment was flown by seven different pilots with the following time distribution:

Day VMC	11.4 hours
Night VMC	3.9 hours
Day IMC	5.6 hours
Simulated IMC	13.4 hours
Total	34.3 hours

Types of missions flown included navigation, formation, slinging and hoisting, confined area operations, slope operations and

simulated instrument flying. Following each mission, the pilot who flew the PVHD made an entry in his Pilots' PVHD Utilization Log (1). In addition, each pilot completed the PVHD Trial Weekly Questionnaire at the end of each week in which they flew the device. (1)

The trial spanned the dates of 31 Jul 80 to 23 Sep 80. On 23 Sep 80 the trial director visited the Squadron, administered the final questionnaire (1) and carried out a post-trial debriefing with the pilots.

RESULTS

From the replies on the weekly and final questionnaires, the majority of pilots who flew the device were certain that the PVHD would reduce pilot workload in certain flying missions/manoeuvers, and that it could be an aid to flight safety in some circumstances. Two pilots were not absolutely convinced of this.

Replies to questions in the final questionnaire revealed that all the pilots were convinced or partly convinced that the concept could prevent disorientation catastrophies.

The majority of those who flew the device also consider that it has potential to reduce pilot workload during all phases of instrument flight.

With regard to equipment design improvements, the following opinions were general amongst those who flew the equipment:

a. the thickness of the light bar most desireable is about one half inch;

b. the lighting preference for the bar is dim white or red at night, and white during the day;

c. the pilots prefer to have the capability of selecting different pitch sensitivities;

d. they prefer that the bar moves in a fixed line up and down the panel as in the existing model, rather than 90 degrees to the bar;

e. they prefer to be able to control the brightness of the bar;

f. they would like to see the bar projected on both sides of the cockpit; and

g. many reported that the bar was too dim and diffuse towards the outer (lateral) edges.

Generally the consensus was that the device has no value during the day if a horizon is present and has limited value at night with a good natural horizon. However, in conditions of actual

instrument flying or simulated instrument flying, comments were very positive. Some of these comments were:

a. "During simulated IFR, I tried to induce vertigo by doing manoeuvers and flying in circumstances which previously had induced some mild form of disorientation, but could not disorient myself."

b. "It would make transition from visual conditions to instrument flight easier and safer and would be very useful on over water flights in limited visibility or in snow showers."

c. "In IFR (actual conditions) it seems to help detect aircraft movements and bring your attention to the Attitude Indicator (AI). Less time is spent on the AI during the crosscheck because you seem to know when it changes versus having to look at it most of the time."

d. "I find it to be extremely useful for recovery from unusual attitudes."

e. "It appears to have potential but it is difficult to evaluate a piece of kit that has an indirect (subconscious) effect on you."

DISCUSSION

The decision to trial the PVHD in the tactical helicopter role was based on aircraft availability, available flying time and the relative ease of operating from a fixed base. In retrospect, the equipment would have been more appropriately challenged by a trial in an environment where more routine flying occurs without a visible horizon, e.g. maritime helicopter operations.

It is difficult, as one pilot reports, to achieve a valid evaluation of equipment on a field trial which relies on the subjects' impressions when the equipment being evaluated is designed to provide information to the subconscious level of brain activity. This is particularly difficult when it involves an information gathering process such as a pilot uses for instrument flying. Pilots, by the time they are operational, have developed a fairly rigid instrument cross-check pattern. This pattern using the conventional flight instruments has served them well, often for years of safe simulated or actual instrument flight. A problem thus exists when you add another attitude information source. They tend to include it in their cross-check and use it as just another instrument. To overcome this tendency would take many hours of exposure to the PVHD with conscious practise in not looking directly at the bar.

The problem of evaluating the effect of information arriving at the subconscious level can really only be evaluated objectively by work-load and flight accuracy measuring techniques. Such techniques are available to the scientist. There are aircraft equipped with measuring devices for control input and aircraft attitude movements

which could be used in a controlled study to measure the difference in workload for pilots flying with or without the PVHD.

CONCLUSIONS

The conceptual flight trials of the PVHD in the tactical helicopter role with 403 Squadron at CFB Gagetown provided much useful conceptual and design information. The device is considered to have considerable potential in actual instrument flying conditions, both for reducing work-load and as an aid in recovery from unusual attitudes. The pilot opinion regarding desired design changes is considered very valid.

RECOMMENDATIONS

1. In order to further measure the potential of the PVHD it is recommended that two further flight trials be conducted:

   a. A similar trial to this, conducted in the maritime helicopter environment; and

   b. An objective, controlled flight trial using an aircraft with appropriate work-load measuring devices.

2. It is further recommended that the pilot opinion regarding design changes be considered in the development of future models.

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Personnel involved in the conduct of the trial were as follows:-

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Squadron Trial Pilots	Maj G. McPhail- 403 Sqn
	Capt D. Morris- 403 Sqn
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Technician	Cpl W. Lyon - 403 Sqn

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